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Detailed Spatial and Temporal Observations of Snow Covers in Mountainous Watersheds Using Numerous Low-Cost Standalone Sensors

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The study presents an innovative approach of augmenting existing meteorological stations with a network of numerous low cost, yet accurate, snow monitoring stations (LOCUS) delivering highly distributed data on snow cover and climate conditions throughout the study basins. Data collected by the sensors currently include: snow height, air temperature and humidity, and total precipitation. A new generation of sensors being developed will also monitor global radiation, wind speed, and snow temperature. The stations are placed within the study basins to cover a wide range of slope elevations, angles, and expositions as a stratified sampling design. Furthermore, "paired stations" located in close proximity to each other, one in an open field and one underneath various forest canopies, were set up to investigate the influence of the vegetation cover on snow accumulation and ablation. Additionally, time-lapse cameras were installed providing continuous information on snow interception in the forest canopies, the state of precipitation, snow heights and snow albedo.

The collected data will be used to assess the naturally occurring spatial variability resulting from topography and vegetation in snow accumulation and snowmelt processes including meltwater runoff. Subsequently, several models with different approaches of handling the spatial heterogeneity of the relevant processes will be tested and evaluated in three study basins with differing topographic characteristics. Models used will include complex, physically-based research models and simpler, process and index based, models that can be used for flood forecasting.

The project specifically focuses on the modeling and forecast of runoff, especially stormflow runoff, from small and mid-size river basins (<100km2) during the winter period. Special consideration will be given to the prediction of "rain on snow" (ROS) events in intermediate mountain regions, as these events have been shown to frequently produce potentially dangerous floods in such basins. A reliable forecast of such events can currently not be guaranteed by the flood forecasting agencies. It requires detailed knowledge about the spatial variability of the snow cover and the snowmelt energy balance and the ability to include this knowledge in model applications. Two ROS events that occurred shortly after the initiation of the project further illustrated the need for further research as the stormflow runoffs for both events was poorly forecast. Our data shows the influence of the "pre-event" snow cover on the overall stormflow runoff. Furthermore, an analysis showed the importance of the spatial variability within the basin snow cover for the runoff during these two ROS events.